

AMENDMENTS TO THE SPECIFICATION

Please amend paragraph [0014], [0016], [0017], [0030], [0035], [0036], [0043], [0056], [0060], [0063], [0065], [0069], [0071], [0072], [0084], [0085] and [0087], as follows:

[0014] A plurality of forwarding processors are positioned in different corresponding ones of the plurality of line connection units, to ascertain output ~~ports~~ direction of each packet received from an external router by looking up forwarding information stored in their corresponding forwarding tables ~~for each packet received from an external router~~, and then transmit each of those packets to the output ~~[[port]]~~ direction ascertained from the forwarding table. The forwarding processors determine whether an output ~~port for~~ direction of a packet input from the switching unit is ~~connected to~~ toward the external router or switching unit by searching among the forwarding information stored in the forwarding table for the corresponding packet, transmit that packet to the external router whenever the output ~~port is connected to~~ direction is toward the external router, and discard that packet whenever the output ~~port is connected to~~ direction is toward the switching unit. The forwarding processors receive the up-dated changes in routing information broadcast by the main processor through the internal IPC paths of the distributed router, and then update their forwarding tables on the basis of those changes in the routing information.

[0016] A plurality of forwarding processors are located in different corresponding ones of the plurality of line connection units, looking-up forwarding information in the corresponding

forwarding table in order to ascertain an output ~~port for~~ direction of a packet received from an external router, and transmit that packet ~~to the output port~~ toward the output direction ascertained. The forwarding processors determine whether an output ~~port for~~ direction of a packet input from the switching unit is ~~connected to~~ toward the external router or switching unit by making a searching among the forwarding information stored in the forwarding table for the corresponding packet, transmit that packet to the external router whenever the output ~~port is connected to~~ direction is toward the external router, and discard that packet whenever the output ~~port is connected to~~ direction is toward the switching unit. The forwarding processors receive the changed routing information broadcast by the main processor through the internal IPC paths of the distributed router, and then update their associated forwarding table on the basis of the changes in routing information.

[0017] Further embodiments of the principles of the present invention provide ping-pong prevention using a distributed router. The distributed router may be implemented with a main process or, a plurality of line connection units and a switching unit. In a first step of the process, the main processor updates a routing table, and transmits the changes in the routing information to the respective line connection units through internal IPC paths of the distributed router whenever the main processor receives changed routing information from an adjacent router. In a second step, forwarding processors located in each of the line connection units receive the changes in routing information broadcasted from the main processor through the internal paths of the distributed router, and updates an associated forwarding table. In a third step, the forwarding processor receives a packet from either an external router or the switching unit, ascertains input and output ~~[[ports]]~~

directions of this packet, discharges that packet whenever ~~[[the]]~~ both input and output ~~[[ports]]~~ are ~~connected to~~ toward the switching unit, and transmits that packet whenever either or both of the input and output ~~ports are not connected to~~ directions are not toward the switching unit.

[0030] When forwarding processors 31 through 3n receive packets, forwarding processors 32 search forwarding tables 31a, 32a, 33a through ~~[[3n]]~~ 3na so as to forward the packets to gateways corresponding to the destination addresses of the packets. For example, when forwarding processor 31 receives a packet having a destination address 200.1.1.1 through the ingress for physical connection unit 11, forwarding processor 31 searches forwarding table 31a. In this case, forwarding processor 31 searches among the routing entries in forwarding table 31a for a gateway address 10.2.1.1 corresponding to the destination address 200.1.1.1. Accordingly, that packet is switched by switching unit 40, and forwarded to the egress of physical connection unit 12 through forwarding processor 32.

[0035] In this case, when main processor 50 is notified by an external router that ~~[[a]]~~ path 2 toward the destination address has changed to a path 1 toward line connection unit №3 73, main processor 50 should transmit the changed routing information to the respective line connection units 71, 72, 73 through switching unit 60. A time difference resides in the transmission of the changes in routing information to the respective line connection units 71, 72, 73.

[0036] If the changes in routing information representing a shift from path 2 to path 1 is

transmitted to line connection unit № 2 72 before the transmission of the packet, line connection unit №2 72 retransmits that packet received from line connection unit №1 71 to line connection unit №3 73 via path 3. In this scenario, if the changes in routing information has not yet reached line connection unit №3 73, line connection unit № 3 73 repeats the transmission and reception of the packet to and from line connection unit № 2 72, that ~~[[is;]]~~ is: line connection unit №3 73 firstly transmits to line connection unit №2 72 the packet received from line connection unit №1 71, and then receives a return of that packet along path 3 from line connection unit №2 72, which had earlier received the changes in routing information.

[0043] Forwarding processors 311 and 321 are located within in line connection units 310 and 320, respectively, and function to receive packets from either an external router 344 or from switching unit 330, and to transmit the packets received ~~[[to]]~~ toward an output port direction that is ascertained by searching of the forwarding information stored in the corresponding forwarding table.

[0056] If it is determined that the destination path of a packet is toward the same ~~output port~~ ~~connected to~~ switching unit 330 from which the packet was originally received, a ping-pong phenomenon is prevented by discarding this packet. In other words, when a packet is received from switching unit 330 by either main processor 340 or by forwarding processors 311, 312 of line connection units 310, 320, and the address carried by that packet indicates that the destination address of that packet is back through switching unit 330, the designation address is recognized

as erroneous and that packet is discarded, thereby preventing that packet from being subjected to the ping-pong phenomenon and with repeated erroneous transmissions from, and to, switching unit 330 precipitated, by, for example, out-of-date routing information.

[0060] Forwarding table 314 is generally constructed of a lookup table 314a and a forwarding cache table 314b. Lookup table 314a stores address indexes for forwarding cache table 314b intended for lookup, while forwarding cache table 314b stores forwarding information for the packets in correspondence to each address index stored in lookup table 314a. Here, the forwarding information includes output ~~[[ports]]~~ directions and Media Access Control (MAC) addresses to which the packet of interest is to be transmitted.

[0063] Lookup control unit 403 uses the IP address to latch the address index of forwarding cache table 314b to which the corresponding IP address is intended to make reference from the lookup table 314a, looks up corresponding forwarding cache table 314b to read the forwarding information of the corresponding packet from the corresponding forwarding cache table 314b, and discards the corresponding packet when the corresponding packet has such an output ~~[[port]]~~ direction that ~~does not direct to an output port connected~~ is not toward outside but ~~[[to]]~~ toward the switching unit into which the packet has been inputted, thereby preventing the ping-pong phenomenon.

[0065] IP packet transmitting unit 406 functions to transmit the packets stored in IP packet

storing unit 405 to the neighboring external router using information of the output [[ports]] directions.

[0069] In more detail, in the case of a [[VAN]] VPN lookup, the VPN route identification and destination address correspond to the information required for a service lookup. In the case of a real-time service lookup, the IP destination address corresponds to the information required for a service lookup. In the case of an emulated leased line service, the IP destination address and IP source address correspond to the information required for a service lookup.

[0071] Here, the forwarding information stored in the corresponding forwarding cache table 314b contains information on the MAC address of the destination, the output [[port]] direction, a maximum transmission unit of the output port. In addition, stored transmission connection information, packet class information, VPN stacking label information, Differentiated Service (DS) information and so forth may be contained.

[0072] Ping-pong check unit 503 extracts information on the output [[port]] direction from the forwarding information which is read from forwarding cache table 314b by lookup unit 502, and checks whether, or not, the extracted output [[port]] direction matches with an input [[port]] direction read at lookup information storing unit 501. As a result of checking, when the output [[port]] direction of the corresponding packet ~~does not belong to a packet directed to~~ is not toward switching unit 330 into which the packet has been input, a determination is made to transmit the

packet. When however, the output [[port]] direction of the corresponding packet ~~belongs to the packet directed to~~ is toward the switching unit from which the packet has been input, a determination is made to discard the packet.

[0084] Lookup control unit 403 extracts information on an output [[port]] direction of the corresponding packet from the forwarding information read from the forwarding cache table 314b, and checks whether the output [[port]] direction of the corresponding packet matches with an input [[port]] direction of inputted packet or not at step 218.

[0085] As a result of checking, when the output [[port]] direction of the corresponding packet ~~does not belong to a packet directed to~~ is not toward the switching unit into which the packet has been inputted, it is determined to transmit the packet at step 220. When however, the output [[port]] direction of the corresponding packet ~~belongs to the packet directed to~~ is toward the switching unit into which the packet has been input, a determination is made to discard the packet at step 222.

[0087] Thus, IP packet transmitting unit 406 reads the packet stored in IP packet storing unit 405 and transmits the read packet through the corresponding output [[port]] direction in correspondence with the forwarding information.